



# Citywide Inclusive Sanitation Through Scheduled Desludging Services: Emerging Experience From India

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The focus of Swachh Bharat Mission (Clean India Mission) was to build toilets to make India open defecation free. While India has succeeded in achieving this goal, to move toward “safely managed sanitation” as per target 6.2 of the Sustainable Development Goals, it is necessary to ensure that all fecal waste is safely collected and treated. The common practice for desludging of septic tanks is “demand-based desludging” rather than a regular service. Such practices have adverse social and environmental impacts. To overcome these shortcomings, scheduled desludging is advocated. This paper first reviews the need for regular desludging of septic tanks. It then outlines the emerging experience of design and implementation of scheduled desludging for inclusive, equitable, and sustainable sanitation to achieve social and environmental benefits in two Indian cities. In these cities, a performance-linked annuity payment framework is used to engage a private desludging enterprise. Payment is met through a sanitation tax and transfer from the general property taxes. It outlines the benefits of scheduled desludging in Indian cities and argues that it is critical to achieve improved sanitation.

**Keywords:** scheduled desludging, India, business models, fecal sludge management, inclusive, citywide, sanitation, private sector participation

## INTRODUCTION

In August 2014, the Government of India launched the Swachh Bharat Mission that aimed to make India open defecation free. Since its launch, nearly six million toilets have been built in cities across India and 83% of cities have become open defecation free (Swachh Bharat Mission, 2019). The challenge now in India is to move beyond toilet construction and ensure safely managed sanitation to meet the sanitation target of Sustainable Development Goal 6 (SDG–6.2). There are lessons from Bangladesh, which was open defecation free in 2015, yet sanitation challenges remained. “The Bangladesh experience has shown that declaring thousands of villages as 100 percent or open defecation free (ODF) is just the beginning of this success story... a lot more needs to be done” (Hanchett and Akhter, 2015, p. 24). Similarly, provision of toilets in Jakarta without adequate attention to the entire sanitation service chain did not improve sanitary conditions. “Although the percentage of residents in Jakarta with access to improved sanitation facilities has reached 87% (2% to sewer systems, 85% to septic tanks), the rivers in the city have become natural sewers” (Japan International Cooperation Agency [JICA], 2012, as quoted in Hashimoto, 2019, p. 2).

In India, of 4,700 cities, only 400 cities have sewerage networks that are connected to treatment plants. “Smaller cities and towns have found it extremely difficult to extend sewerage services, in part because they rarely have enough water, uninterrupted power supply, skilled staff, capital, or planning capacity” (Narayanan et al., 2017, p. 228). These small cities, of populations <100,000, are fully dependent on onsite sanitation systems. In these cities, toilets are usually connected to septic tanks. The design, construction, and maintenance of septic tanks is, typically, the responsibility of households. There are two problems in having safely managed sanitation with this system. First, the septic tanks are not desludged regularly. Irregular and delayed desludging affects the effective functioning of septic tanks. Secondly, emptying charges are high and the poor and low-income households avoid using toilets so that their tanks are not filled up. Further, when the tanks overflow, the septage seeps into the ground and mixes with drinking water sources. This has negative environmental impacts on groundwater and surface water, and eventually on the health of local populations.

This paper is based on the experience of scheduled desludging in the two cities of Wai and Sinnar in Maharashtra (India). Wai has a population of 43,000; Sinnar of 80,000. In Wai, scheduled desludging operations have been going on for nearly a year; in Sinnar, for five months. It is for the first time in India that an effort to desludge septic tanks regularly, as a public service, has been initiated. The paper describes the experience of implementing scheduled desludging services in these two cities. It also reviews various service models for desludging in Asia. The paper also argues that scheduled desludging is inclusive, equitable, and a sustainable fecal sludge management (FSM) practice.

## NEED FOR REGULAR DESLUDGING OF SEPTIC TANKS

A septic tank is designed as a preliminary treatment unit where the settled solids are anaerobically digested. The liquid portion or effluent from septic tanks overflows to soak pits or soakaway fields. “The effluent although clarified to a large extent, will still contain appreciable amount of dissolved and suspended putrescible organic solids and pathogens” [Central Public Health and Environmental Engineering Organisation (CPHEEO), 2013, p. 9–18]. The Central Public Health and Environmental Engineering Organization guidelines recommend that the settled solids from a septic tank need to be desludged on a regular basis for it to function well. It suggests that “yearly desludging of septic tank is desirable, but if it is not feasible or economical, then septic tanks should be cleaned at least once in 2–3 years, provided the tank is not overloaded due to use by more than the number of persons for which it is designed” [Central Public Health and Environmental Engineering Organisation (CPHEEO), 2013, p. 9–22].

Studies have suggested that a desludging frequency of <1 year disrupts the biological process and results in lower digestion rates. For example, “anything from 2 to 5 years is required for the biological processes to develop fully within a septic tank and

allow the system to operate properly” (Gill et al., 2016, p. 2). “A higher desludging frequency which is more than designed period, results in substantial portion of solids escaping with effluent” [Central Public Health and Environmental Engineering Organisation (CPHEEO), 2013, p. 9–18]. “These unemptied systems can continue to operate for much longer than designed (some systems have been used for more than 20 years without being emptied) but no longer function as septic systems. When eventually such tanks are emptied, the heavily solidified sludge is difficult to pump out or must be removed manually” (SNV, 2019, p. 8).

“In the United States, where 25% of the population uses a septic tank, the Environmental Protection Agency recommends sludge pump-outs every 4 years, but the final decision is left to the users [Environmental Protection Agency (EPA), 1999, as quoted in Hashimoto, 2019, p. 4]. The United States Agency for International Development (USAID, 2010) indicates that in a regularly desludged system, sludge fills less than one-third of the tank. The Swiss Federal Institute of Aquatic Science and Technology (EAWAG) recommends desludging a septic tank every 2–5 years (Swiss Federal Institute of Aquatic Science and Technology (EAWAG), 2008). In Japan, desludging once a year is a legal obligation for household packaged aerated wastewater treatment plants (PAWTPs, or Johkasou in Japanese) users” (Hashimoto, 2019).

The results of a field study conducted on septic tanks in Ireland, and states that “a desludging frequency of 3 years is optimal for septic tank systems over 3.5 m<sup>3</sup>, depending on household occupancy. Beyond 5 years, however, the sludge volume in some systems had exceeded the recommended volume limit, and so an upper limit of desludging within at least a 5-year period is essential” (Gill et al., 2016, p. 31).

Many countries have their own standards for desludging frequency of septic tanks. A review across countries in **Table 1** suggests that the norm for regular desludging ranges from 2 to 5 years. The two important factors that determine septic tank desludging frequency are number of users and size of septic tanks. Smaller sized septic tank will require frequent desludging as compared to larger sized septic tanks. Similarly, more users mean a higher septage accumulation rate and higher desludging frequency.

In all the countries referred to in **Table 1**, the primary responsibility is of the household to get the septic tank inspected and desludged. However, this is not the case in India and other developing countries. It is usually the responsibility of local governments to inspect septic tanks. Some local governments in India do provide desludging services for a fee, but only when they are called upon to do so. In many cities, it is the unregulated private desludgers who provide this service. The desludgers are called only when there is backflow from the tank to toilets or the tank is overflowing and the neighbors complain. Under these circumstances, the desludgers often charge high user fees (US\$40–70). In the absence of any fecal sludge treatment plant nearby, the desludged septage is let out in water bodies or on open grounds or is used on farms without treatment.

**TABLE 1** | Standards for frequency of septic tank desludging.

Country	Septic tank desludging frequency	Agency setting the norm
1 India	2–3 years	Central Public Health and Environmental Engineering Organisation (CPHEEO), 2013
2 USA	Every 3 years	Environmental Protection Agency (EPA) (2005), A Homeowner's Guide to Septic Systems
3 Australia	Every 5 years	Department of Health, Australian Government, 2010
4 Ireland	5 years or depending on the septic tank capacity and the number of people living in the house	The Water Services (Amendment) Act 2012
5 Malaysia	Every 2 years	MS 1228 on Design of sewerage system [Standards and Industrial Research Institute of Malaysia (SIRIM), 1991; Span, 2009]
6 Philippines	Inspected at least once a year and be cleaned when the bottom of the scum mat is within 7.50 cm (3 inches) of the bottom of the outlet device	Sewage Collection And Disposal, Excreta Disposal And Drainage Of The Code On Sanitation Of The Philippines (P.D. 856.) (Department of Health, Manila, Philippines, 1995)
7 Canada	Inspect the system every 3–5 years and pump out the solids and scum when required	Ontario Septic Smart-Understanding Your Home's Septic System; Canadian Environmental Protection Act (R.R.O., 1990), Reg. 358: sewage systems (Last amendment: O. Reg. 244/09.) (R.R.O., 1990; WHO, n.d.)

## SCHEDULED DESLUDGING—EXPERIENCE FROM TWO CITIES IN INDIA

Scheduled desludging represents a planned effort to ensure regular desludging. In this, every property is covered along a defined route and the property occupiers are informed in advance about desludging. The local governments of Wai and Sinnar in India decided to introduce a scheduled desludging through a public private partnership (PPP) arrangement and built fecal sludge treatment plants. Scheduled desludging in the two cities is provided as a municipal service to all properties. This makes it inclusive as all properties in the city receive the service. This includes both residential and non-residential properties. Low income households and those staying in slums are also being able to receive the service.

### Scheduled Desludging Through Public Private Partnership

The desludging service is provided in these cities as per a planned schedule to cover all residential and non-residential properties over a 3-year cycle. For this, the city area has been divided into three zones and each zone is planned to be covered in a year. Desludging is done by a private company that has entered into a

performance-linked annuity contract with the local governments. The payment to the private provider is made by the local government against the targeted performance. A “sanitation tax” is added to each property tax bill to cover the payments made by local government to the desludging company.

### Performance-Based Payment Contract

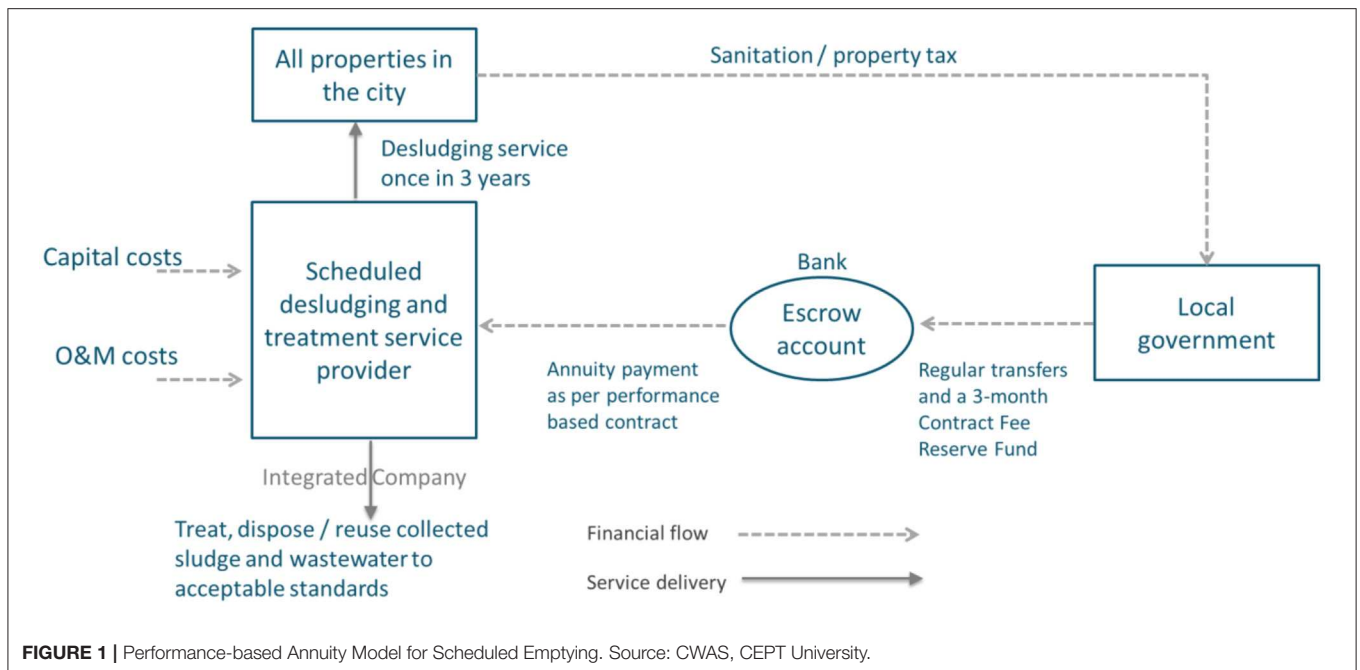
A “performance-based” contract for desludging was developed for these two cities. Payments under this contract are made against the number of septic tanks emptied and safe discharge at the designated treatment site. The key clauses in the contract enforce high performance standards and safety compliance at the time of desludging septic tanks, requirement of safety gear for workers, quality of suction trucks, cleaning up of spillage, etc. This contract is a service level agreement which protects the interests of all parties—private sector, city governments, and citizens. It has helped the local government to receive good quality regular desludging services for all the properties. While the private service providers make investments in trucks, they get a fixed business and assurance of monthly payments against number of septic tanks emptied.

The private service provider in each city was competitively selected through a standard government e-tender process. In both cities, the bid price for desludging a tank was one-third of the charges levied for demand desludging. The total annual contract value was only 1.8% of total annual revenue expenditure of local governments. It was thus possible to fund this activity through local budgets, but both cities decided to levy a “sanitation tax” to fund this activity.

The risk of late payment by local governments was raised by several private service providers in pre-bid meetings. To mitigate this, an escrow account mechanism—a tripartite agreement between the local government, private sector, and a local bank—was introduced. The local government is required to keep 3 months of contract payment as a reserve fund to safeguard against risk of payment. **Figure 1** depicts the performance-linked annuity model for scheduled desludging services implemented in Wai and Sinnar.

### Financing Scheduled Emptying Through a Sanitation Tax

For financing the scheduled desludging services, both cities have levied a sanitation tax. The sanitation tax is part of overall property tax which is paid annually by property owners to local governments for various services. This allows the tax to be more equitable as those with larger and better properties pay a higher property tax. This will also make the desludging service more affordable for the low income groups. The sanitation tax ensures that adequate funds are available for annuity payments to the private service provider. The amount collected from sanitation tax is sufficient to cover annuity payments for scheduled desludging in Sinnar city, while local government in Wai has to allocate both sanitation tax and some transfer from property tax for financing the scheduled desludging service. The local government of Wai is planning to increase the sanitation tax incrementally over the years. The introduction of sanitation tax and scheduled desludging services were welcomed by the



households of both cities. This was because, as they did not have to pay any money at the time of actual desludging, it was considered as a regular and “free service” provided by the local government.

## Awareness Activities

To ensure successful implementation of the scheduled desludging plan, local government officials, and leaders also carried out awareness activities to sensitize their residents about the importance of regular emptying and treatment of septage. This involved promotional campaigns through local media as well as door-to-door outreach programs to inform households about the plan and its benefits. The awareness material covered important aspects such as need of septic tank emptying, details of the local government scheme, how the citizens should be ready, and what to expect during the process of desludging, etc. Along with local government, the private service provider was also responsible for carrying out awareness activities. Such activities were strategically planned for zones where scheduled desludging is ongoing. Local leaders and citizen representatives were involved in awareness activities to ensure their commitment and citizens’ acceptance for the successful implementation of the sanitation plan. As a result, residents have embraced the scheduled desludging service and are prepared when the desludger arrives at their doorstep as per the schedule.

## Provision for Emergency Services and Apartments

Despite the availability of scheduled desludging, there is always a need for “emergency” desludging from other areas which have not been covered by the service so far. For emergency cleaning, property owners have to first inform the local government instead of calling the private operator directly. The local

government inspects and verifies these requests before asking private operators for desludging. About 20% of desludging is done in response to emergency requests. One key issue in the performance contract concerns the number of properties served by a single septic tank, as the payment is made per septic tank serviced. In Sinnar, this has been addressed by making adjustments in the contract to account for this in case of apartment properties.

## Monitoring Quality of Groundwater and Rivers

It is expected that regular desludging services will eventually improve the quality of both river water and groundwater. For assessing this, water quality monitoring has been initiated. The water quality monitoring regime was prepared to identify sample locations, parameters to be tested, and sampling procedure for collecting the samples. This was based on the guidelines provided by the Central Pollution Control Board and the Maharashtra State Pollution Control Board. A study was conducted to test the quality of effluent flowing in drains, groundwater, and river water quality at the start of implementing the scheduled desludging. These tests will be repeated every year for the next 3 years to track improvement in water quality. The authors hope to report results of these tests in the near future.

## Result of Scheduled Desludging Services in Wai and Sinnar, India

In Wai, over the year, 1,500 properties received desludging services and over 4.8 million liters of septage was delivered and treated at the fecal sludge treatment plant. Nearly 95% of the households and property owners have welcomed scheduled desludging service. In Sinnar, in 5 months of operations, 686

properties received desludging services and over 2.85 million liters of septage was delivered and treated at the fecal sludge treatment plant. The acceptance rate in Sinnar was 80%. The few who did not accept the service in both cities were the ones whose tanks had been desludged recently.

The scheduled desludging program initially faced some challenges. The residents were informed 2 days prior of their turn of desludging and were asked to keep their septic tank cover open on the day of desludging. But many septic tanks did not have a proper access cover or were sealed in such a way that it was difficult for the households to open it. This resulted in delays in desludging and affected operational efficiency. To overcome this challenge, the local government appointed a mason who would go along with the desludging operator and help open the seal as well as close it after desludging. This has helped in increasing operational efficiency. The other challenge was the lack of a proper repair service during breakdown of desludging vehicles. The pump stopped functioning when the septage was too thick. The desludger has replaced the suction pump in Wai with a higher capacity and it functions well now. But major breakdowns of desludging vehicles were repaired at the desludgers' head office, nearly 70 km away. This meant that desludging operations had to be curtailed for a day or two.

Three months prior to the introduction of scheduled desludging, awareness campaigns were launched in both cities. As a result of these campaigns, residents from all over the city started demanding desludging services. So the campaign had to be redesigned and launched only in the zone that was designated for desludging.

These initial challenges have meant that the desludger has to work harder to achieve the monthly targets set in the contract. The contract terms have also been revised to take into account the unforeseen delays in desludging operations. The “model” contract for scheduled desludging has also been revised accordingly, so that other cities in India that are planning for scheduled desludging can use this revised contract.

## POTENTIAL BENEFITS OF SCHEDULED DESLUDGING IN INDIAN CITIES

Regular desludging is recommended by several countries for the safe and proper functioning of septic tanks. The emerging experience of scheduled desludging in these two Indian cities suggests several benefits including safe, inclusive, and affordable sanitation systems. In addition, the desludging charge is covered through sanitation tax linked to property tax. Thus, households do not pay any fee directly to the desludger. Such a scheduled emptying service has high acceptance and can help achieve a number of benefits.

### Achieves the Norms Through Regular Desludging

Service performance information from five states in India covering more than 900 cities suggests that septic tanks are not desludged regularly (<https://www.pas.org.in>). Detailed surveys

were conducted in the two cities of Wai and Sinnar before the implementation of scheduled desludging, to understand the baseline situation (household size, size of septic tank, connection of septic tank outflow, accessibility of septic tanks from roads, when desludged last, payment for desludging, etc.), and develop an implementation plan. These surveys suggested an average desludging frequency of around 10 years in Wai and Sinnar. With the implementation of scheduled desludging in these cities, desludging is planned for once in 3 years for all septic tanks.

### Reduces High Prices of Desludging

Demand-based desludging practices are often hard to regulate and result in high prices for desludging, especially for the poor and in small towns. In Maharashtra, where such data are available through, prices range from INR 3,000 to 5,000 (US\$40–70 per trip). Households generally pay these high charges as a “distress price” as they have no other recourse. These high charges also indirectly affect the sustainability of an open defecation free city situation, as some household members may choose to defecate in the open so that the tank does not become full. Desludging charges are generally higher in smaller cities and in areas outside the local government boundaries. This is often the case as the private desludgers are usually based in large cities, where they have better business. In smaller towns, their travel costs are added to those for providing services, resulting in higher prices. As a consequence, in some small cities, a high fee of INR 7,000 (US\$100) per trip is charged. Instead, when scheduled desludging was introduced in Wai and Sinnar, the desludgers charged INR 800 (US\$12). Thus, scheduled desludging has reduced the charge by nearly one-third. It is important to note that for a private enterprise, there are fixed costs related to overhead and office establishment which decrease by increasing the volume (for example, number of tanks that are emptied). Under a scheduled emptying regime, the market size in terms of number of septic tanks to be emptied every day is known. Private enterprises use their trucks optimally by proper route planning and reduce their operational costs significantly.

### Removes the Need for Manual Labor

Lack of regular desludging also has adverse social impacts as the need for manual labor increases with the hardening of sludge inside septic tanks and pits. In India, manual scavenging is a criminal offense under the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act of 2013. It prohibits use of insanitary latrines, and employment and engagement of manual labor for cleaning of sewers and septic tanks. However, despite this, a large number of manual workers are employed for this work. A government survey has identified 54,130 people engaged in this job as of July 2019 (Sen, 2019) and more than 600 workers have died while cleaning septic tanks and sewers across the India as reported by the National Commission for Safai Karamcharis [NDTV (New Delhi Television), 2018]. Regular desludging in these two cities of Maharashtra has eliminated the need for manual workers.

## Improves Environmental and Public Health Impacts

Irregular and delayed desludging can also result in increased chances of accidental overflows of fecal matter from septic tanks to open drains. In addition, overflow of supernatant with pathogens leads to groundwater and surface water pollution and other adverse environmental impacts. A study by Gretsche et al. (2016) conducted in four low-income neighborhoods in Accra, Ghana, showed high levels of fecal contamination in open drains.

The authors carried out a study of open drains in cities in Maharashtra, including Wai and Sinnar. Tests of drain water in Wai showed BOD levels of 346 mg/l and fecal coliform levels of >1,600 MPN/100 ml. In other cities, the open drains, where supernatant from septic tanks and gray water mixes, showed fecal coliform levels of >1,600 MPN/100 ml. This drain water goes to the river, thus affecting the quality of the river water. At the downstream end of the river, fecal coliform is >1,000 MPN/100 ml. Groundwater is also affected due to overflows from septic tanks. Ninety-five percent of the samples in these cities showed fecal coliforms levels ranging from 100 to 900 MPN/100 ml.

In contrast, initial results from the zones of two cities where scheduled desludging has been initiated, show that fecal coliform in open drains is below 100 MPN/100 ml. However, we cannot yet establish that there is a direct impact on the health of people in these two cities.

“Linking sanitation services and health impacts is complex” (Mills et al., 2017, p. 2). It is expected that improved sanitation services through regular desludging and proper treatment of fecal sludge will have positive health impacts. However, impact on public health is always difficult to measure and attribute directly to improved sanitation. “While the magnitude of direct health impacts is uncertain, it is generally accepted that inadequate sanitation and exposure to fecal pathogens affect health, and there is growing evidence that the burden of disease may be higher due to long term effects of environmental enteropathy and stunting” (Mills et al., 2017, p. 2).

## Links With Local Taxes Rather Than With User Charges

Sanitation is a public good and most public goods are partially funded through taxation. In this vein, scheduled desludging in these two cities is provided as a service by the city government, and is linked to sanitation/property tax. This practice is adopted in other countries as well. Robbins et al. (2012) suggests that in the Philippines, except for Dumaguete, which charges a small user fee, other cities have either a flat tax linked to property tax or a surcharge on water fees. One advantage of this approach is that no user charge/fee has to be paid at the time of emptying. This makes it attractive for property owners to avail of desludging services when their turn comes. This is evident from experiences from India and the Philippines where there is a good response to emptying, because users of the service perceive this as a public service like garbage collection, paid through taxes. In contrast, in Malaysia and Indonesia, which relied on user charges to be paid

during desludging, the response to scheduled emptying has been poor (See CEPT University, 2019b).

## SERVICE MODELS FOR FSM USING SCHEDULED DESLUDGING

In the case of sanitation, and particularly FSM, it is important to recognize that sanitation is, foremost, a public service. For example, the new World Health Organization’s Guidelines for Sanitation and Health suggest to “define sanitation at sub-national level as a basic service for which local government is responsible and accountable” [World Health Organization (WHO), 2018, p. 21]. So instead of the usual “business model,” it is treated as a “service model” in this paper.

A service model is defined as model for a public service and outlines the manner in which a service is structured financed, and management arrangements made for its delivery. Appropriate service models are needed to ensure that these services are provided in a sustainable manner, and the related institutional and financing arrangements need to fit within the prevailing regulatory regimes.

## Experience in Scheduled Desludging in Asia

Scheduled desludging has been initiated in several Asian counties including the Philippines, Malaysia, Vietnam, Indonesia, and India. The experience varies across these and provides some key lessons.

### The Philippines

FSM activities were initiated in the context of the National Sewerage and Septage Management Plan in 2012. It provided up to 40% of costs of sewerage or septage management programs of local cities and municipalities. Robbins et al. (2012) provide details of the approaches used in different cities where scheduled regulated desludging is being successfully implemented—Dumaguete, San Fernando, Baliwag, Metro Manila, and others.

In both Dumaguete and Baliwag, desludging services are provided jointly by city local governments and water districts. The city water districts are responsible for investing in trucks’ capital and operational cost, while local government operates and maintains treatment plants. The scheduled desludging service follows a cleaning cycle of 5 years and households pay the desludging charges as part of their monthly water bill, at tariff of PHP 2.00 (US\$0.05) per cubic meter of water consumed. The local ordinance developed in Dumaguete serves as a good model for scheduled desludging by establishing clear septage management policies and institutional arrangements. It involved establishing clear standards for septic tank size, desludging frequency, septage treatment, user fees and penalties, and monitoring mechanisms. Furthermore, in Dumaguete, a City Septage Management Authority was established, comprising representatives from the local environmental, health, water, engineering, legal, and financial departments. This has ensured smooth functioning of the program and promotes inter-agency coordination. In Metro Manila the private sector provider,

through a PPP for water and sanitation, provides fecal sludge management services in areas not served by sewerage. For this, an environmental fee is charged at 20 percent of the water bill.

### Malaysia

Between 1993 and 2013, the government nationalized sewerage services and provided regulated septic tank desludging services through a private concession to Indah Water Konsortium (Indah Waters, 2019). It was responsible for the scheduled desludging program and there was good uptake from 2005 to 2007. This program faced some challenges post-liberalization as there was weak enforcement of septage management policies. The scheduled desludging was not provided as a regular service, and the regulatory agencies did not fine households that failed to do scheduled desludging as per the law (Narayana, 2017). A key reason for the poor sustainability of the program in Malaysia was also the direct user charges that households had to pay, which reduced demand. On the other hand, low collection meant inadequate funding for regular operations. Malaysia now plans to reintroduce scheduled desludging services, learning from the examples of the Philippines and India.

### Indonesia

The Government of Indonesia has taken up a program to introduce scheduled desludging in 69 cities across the country. This model is based on requisitions from customers following an intensive awareness campaign. A mobile app is used for households to request desludging services; they need to register on the online platform and inform about their desludging period. Based on this, a scheduled service is provided either by local government or a private service provider. A dashboard is prepared to monitor the activities of the desludging vehicles. Foort (2018) points out that early and strong commitment of city leadership is needed. The program started with user charges where a cost recovery tariff is used to “cover all direct operational cost of collection, treatment, and direct management” (p. 4). However, Foort (2018) suggests that there is a realization that the “most efficient billing is a for a water utility to combine with the monthly water bill. If that is not possible, it might be possible to combine with property tax” (p. 10).

### Vietnam

Scheduled desludging practice was introduced in Hai Phong. The service was provided by the Hai Phong Sewerage and Drainage Company. The desludging interval was 5–6 years for household septic tanks and 1–2 years for apartment buildings. In Hai Phong, scheduled desludging service for communities was free of charge. The government has increased wastewater fee as 15% of the water fee in Hai Phong city as compared to 10% in other cities. The private firm was allowed to use the entire wastewater fee to recover expenses of scheduled desludging service. However, it was observed that business was incurring losses and part of the expenses had to be paid from the city’s budget. “The main reasons of loss as stated are high annualized depreciation costs, and limited number of trips per truck per day which is much less than break-even point as per their financial analysis” [Institute

of Environmental Science and Engineering (IESE), 2011, p. 119]. The company planned to continue scheduled desludging services with further increased wastewater tariff and through sale of compost from treatment systems to make its fecal sludge management business sustainable.

### Thailand

Private sector-led integrated FSM services to a cluster of settlements have been adopted in Rayong District in Thailand. Thongthawil Service Co. Ltd. provides septage desludging and treatment services in two municipalities and eight subdistrict organizations. The same private firm operates both desludging and treatment services for a group of nearby cities. Annual license fees are collected from the private sector for providing desludging and treatment service. This model offers the option for funding both conveyance and treatment from households through surcharges as a bundled price. An integrated model combining desludging and treatment is a promising model offering high efficiencies, convenience, and easier contracting, with the same player responsible for operations across the value chain.

### Leh, India

The Leh Development Authority, in the Ladakh region of the state of Jammu and Kashmir in India<sup>1</sup>, initiated scheduled desludging integrated services with Blue Water, a private company. It entered into a 5-year contract wherein Blue Water will design, finance, build, and operate the fecal sludge treatment plant on the land provided by the Authority. It will also operate desludging trucks provided by the Authority. In this arrangement, the Leh Authority collects user fees, and 90% of fees are given to the private operator after the service is delivered. This fee covers operational costs and a part of the capital costs for the treatment plant. Differential fees are charged to households and commercial properties of hotels and guesthouses. Through this model, it becomes possible to cross-subsidize services for poor households.

## Five Emerging Service/Business Models

These examples clearly reflect the strong potential and applicability of scheduled desludging models in varied contexts across several Asian countries. Some of the benefits of a scheduled desludging model are improved performance of septic tanks, equitable, and affordable payments by households as part of their monthly water bill, and ensured income for private service providers. Experiences in Dumaguete (the Philippines) and Malaysia also suggest the need for careful design and creating user awareness. It is also important to design scheduled desludging models that are financially viable to ensure sustainable services in the long run. Where it is difficult to fully finance scheduled desludging services through taxes or surcharge of water bills, it will have to be partly financed by local governments.

Based on the various examples from Asia reviewed above, and drawing on CEPT University (2019a,b) data, **Table 2**

<sup>1</sup>Since October 31, 2019, Leh and the erstwhile state of Jammu and Kashmir are separate Union Territories.

**TABLE 2 |** Service/Business Models for Scheduled Desludging.

Model description	Benefits	Need to address	Applicability	Cases
<p><b>1. Scheduled Desludging—PPP Annuity Model:</b> Private service provider brings trucks and operates through a performance-based contract to carry out scheduled desludging on predetermined schedule set by local government. Fees as per the bid are paid to private operators per septic tank emptied. The city collects a sanitation tax or a surcharge on water to cover the payment of fees</p>	Reduces the capex burden for local governments; results in higher service levels; guaranteed fees result in competitive bid prices	Significant information, entertainment and communications (IEC) needed to convince households for desludging; proper monitoring of private sector activities	Presence and willingness of private sector to invest in trucks and capex, and take on contracts; local government has capacity to monitor operations	Wai and Sinnar, Maharashtra, India; Dumaguete, Baliwag, Maynilad and Manila, Philippines
<p><b>2. Scheduled Desludging—Private Sector Partnership (PSP) Annuity Model:</b> The only difference from the above model is that private service provider leases or operates local/state government trucks and carries out desludging operations on a performance-based contract. Fees determined as per the bid</p>	Government capex may incentivize more and smaller private providers to participate	Proper monitoring of private sector activities; possible lack of maintenance of trucks by private operator	Private sector presence, but low capacity to invest, while local/state government has financial and monitoring capacity	Hai Phong, Vietnam; Odisha; Gevrai, Maharashtra, India
<p><b>3. Scheduled Desludging on Requisition:</b> Regular desludging service is provided to only those households that request regular desludging on the household register on the online platform; the private operator then informs households about their regular desludging period and provides service</p>	Can be explored as a potential model for transition from on-demand to scheduled desludging	Focus on IEC to generate buy-in by household/property owner	Applicable in areas where there is considerable variations across properties in containment sizes in a given city	Indonesia
<p><b>4. PPP/PSP-based Integrated Model with Treatment and Scheduled Desludging:</b> The same private firm operates both desludging and treatment services in the city. The treatment facility may be funded by the government or by private sector fully or partially. The trucks are funded by the private firm. Recovery could be from the government (PPP contract) or from desludging charges. Desludging charges from households are the source of opex funding for collection, transport, and treatment. Charges are collected directly by the operator (user charges), or indirectly through the government (FSM taxes), which then pays the operator</p>	Integrated models offer efficiencies, convenience, and easier contracting, with the same private provider	Dependency on a single player: compounds risk of non-performance; and crowds out existing smaller players	There are private players with capacity to manage both treatment and desludging operations	Leh, Jammu and Kashmir, India
<p><b>5. PPP/PSP-based Clustered Integrated Model with Treatment and Scheduled Desludging:</b> As above, except that the same private firm operates both desludging and treatment services for a group of nearby cities</p>	Cluster approach and co-treatment can provide efficiencies in treatment facilities	Cooperation among cities; efficient road connections	As above, but where the nearby cities are willing to come together for a cluster approach; or where a private provider has the capacity to work with several nearby cities	Thailand (Thongthawil Service Co. Ltd.)

Sources: Based on the Landscape studies for Fecal Sludge and Septage (FSSM) Financing and Business Models across four states by CEPT University (2019a,b) (pp. 68–78, 110–118).

describes five models for scheduled desludging. While scheduled desludging is viewed as a public service, the service models recognize the important role of private sector providers in service delivery. Based on experiences from Leh (India) and Thailand, an integrated model that combines services for desludging and treatment by the same service provider is also possible. This model can also be relevant for combining services in rural and urban areas through a cluster-based model. It is also recognized that for larger metro areas, two or three private operators can be appointed using any of these models to serve different areas or zones. This

service model can be applicable for all metros or large cities across India.

## WAY FORWARD

The paper has highlighted the experience of two cities in India where a scheduled desludging model is practiced. It clearly reflects that scheduled desludging is needed to ensure proper functioning of septic tanks. Scheduled desludging fees as sanitation tax and linked to property tax or water bills are more acceptable to households. This also helps achieve equitable



service by including the poor and low-income settlements; helps in cost optimization and thereby reduces payment burden; improves health and safety practices by removing the need for manual cleaning; and achieves positive environmental impacts.

Given the multiple benefits of scheduled desludging services in the Indian context identified above, and the positive experience from the initiative in two cities, it is now being considered by other cities and states in India. The Government of India has recognized the importance of regular cleaning and has recommended desludging of septic tanks at 2-year intervals. Its national FSM policy envisages “Scheduled emptying of septic tanks or other containment systems at an interval of 2–3 years as recommended by the Central Public Health and Environmental Engineering Organization” (Government of India, 2017). This is also critical to ensure universal access to safely managed sanitation services in urban India by 2030.

However, it is also important to note that implementation of scheduled desludging practices require local government commitment, multiple stakeholder involvement and coordination, a focus on awareness activities, strong monitoring systems, and the availability of a treatment facility of adequate capacity. Scheduled desludging practices are also envisaged to lower costs and have positive impacts on public health and environment.

More detailed studies across service models in different counties are needed to identify key practices and develop standard operating procedures, as well as to assess the environmental and health impacts.

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## AUTHOR CONTRIBUTIONS

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